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U. S. NAVAL TECHNICAL MISSION TO JAPAN  
CARE OF FLEET POST OFFICE  
SAN FRANCISCO, CALIFORNIA

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E-09

-14 February 1946

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From: Chief, Naval Technical Mission to Japan.  
To : Chief of Naval Operations.

Subject: Target Report - Japanese Navigational Aids.

Reference: (a) "Intelligence Targets Japan" (DNI) of 4 Sept. 1945.

1. Subject report, dealing with Target E-09 of Fascicle E-1 of reference (a), is submitted herewith.

2. The investigation of the target and the target report were accomplished by Lt. Comdr. M.C. Mains, USN(Ret).

  
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Captain, USN

30609

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## **JAPANESE NAVIGATIONAL AIDS**

**"INTELLIGENCE TARGETS JAPAN" (DNI) OF 4 SEPT. 1945  
FASCICLE E-1, TARGET E-09**

**FEBRUARY 1946**

**U.S. NAVAL TECHNICAL MISSION TO JAPAN**

## SUMMARY

ELECTRONICS TARGETS  
JAPANESE NAVIGATIONAL AIDS

Only one type of navigational aid developed by the Japanese appears to merit detailed study. This is the hyperbolic system, Tachi 39 - Taki 39, developed by the Army, but not put into use.

The Navy had one type of radio altimeter; the Army had two, one of which was unsatisfactory.

The new types of radio beacons for the Navy, still in the developmental stage, are of some interest, and a brief description is given.

Although both airborne and shipborne radar was used to some extent in navigation, no special radar navigational aids were developed, and no use was made of corner reflectors, beacon buoys, or other similar devices.

Radio direction finders are described in NavTechJap report "Japanese Radio and Radar Direction Finders", Index No. E-05, and radar direction-finding, such as it was, in NavTechJap report "Japanese Radar Countermeasures and Visual Signal Display Equipment," Index No. E-07. Underwater devices are described in NavTechJap report "Japanese Sonar and Asdic", Index No. E-10.

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## REFERENCES

REPORTS OF OTHER AGENCIES:

Reports of Air Technical Intelligence Group, Far Eastern Air Forces  
(Sent to the Bureau of Aeronautics and Wright Field).

ATIG #115 - A Short Survey of Japanese Radar.

ATIG #276 - Catalog of Japanese Radio, Radar, and Special  
Electronic Devices of Interest to AAF.

ATIG #253 - A Survey of Japanese Airborne Radio Research and  
Development.

ATIG #277 - Miscellaneous Electronic Documents (List of  
documents sent to Air Documents Division, T-2,  
Wright Field).

Reports of Technical Liason and Investigation Department, Office  
of the Chief Signal Officer, Supreme Commander Allied Powers.  
(TLID). (Available through G-2, War Department, Washington, D.C.).

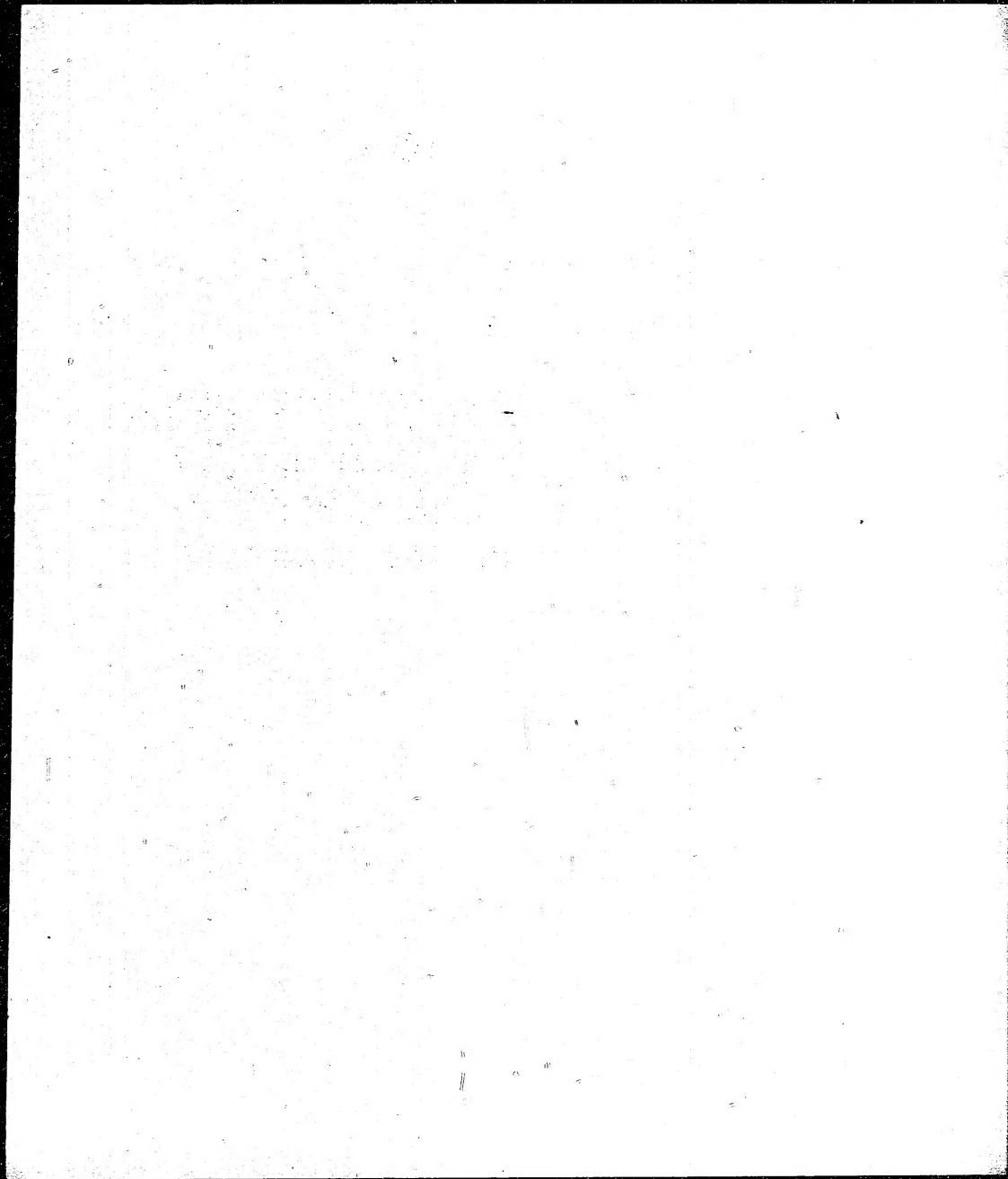
## LIST OF ENCLOSURES

- (A) List of Documents forwarded to WDC through ATIS
- (B) MRB Radio Beacon - Block diagram
- (C) MKR Radio Beacon - Block diagram
- (D) URB Radio Beacon - Block diagram
- (E) FH-1 Radio Altimeter

## INTRODUCTION

Intelligence reports prior to the end of hostilities indicated that the Japanese used altimeters and that some system similar to Loran was being developed. All available sources of information were investigated for further information on these and other possible types of navigational aids. During the investigation, close liaison was maintained with the Electronics Section, Air Technical Intelligence Group, Far Eastern Air Forces, and with the Technical Liaison and Investigation Department, Office of the Chief Signal Officer, Supreme Commander Allied Powers. It is believed that all sources of information were exploited without duplication of effort.

Inasmuch as direction finders and underwater devices have been dealt with in other reports, it was decided to omit any treatment of them here.





# THE REPORT

## A. SHIPBORNE NAVIGATIONAL AIDS

Radio direction finders are described in NavTechJap report "Japanese Radio and Radar Direction Finders", Index No. E-05, and sonar devices are described in NavTechJap report "Japanese Sonar and Asdic", Index No. E-10. The Mark 2, Model 2, 10cm radar was used to some extent for navigational purposes, but no special radar navigational devices were developed for shipboard use.

## B. AIRBORNE NAVIGATIONAL AIDS

Airborne radio direction finders are covered in NavTechJap report, "Japanese Radio and Radar Direction Finders", Index No. E-05.

The H-7 and FM-1 radars were used for air navigation, but no special fittings or techniques for radars were developed for navigational uses.

The Japanese Navy had a frequency-modulated radio altimeter, the FH-1, which operated on a frequency of 340 megacycles plus or minus 15 megacycles. The power output was about 1/10 watt, the range 10 to 150 meters, accuracy within 5%, total weight 25 kg. The antenna consisted of two half-wave dipoles, one for transmitter and one for receiver. A schematic and block diagram will be found in Enclosure (E).

The Army had two altimeters, the Taki 11 for high altitudes and the Taki 13 for low altitude. A description of these, as well as further details on the FH-1, will be found in ATIG Report No. 115, "A Short Survey of Japanese Radar".

The aircraft part of the hyperbolic navigation apparatus mentioned in Part C was a simple super-heterodyne receiver (Taki 39) With a locally generated sweep for the cathode ray tube. The sweep was adjusted until the received pulses were stationary, then a drift pulse was timed with a stop-watch as it moved between the stationary pulses. This time was used to determine a line of position.

A visual-indicating receiver for use with the MKR radio beacon is described in Part C.

## C. LANDBASED NAVIGATIONAL AIDS

The Japanese had in development a hyperbolic navigational system, which was in effect a simple version of LORAN. Original plans were to erect transmitting stations at ONMAEZAKE, (SHIZUOKA Ken), at SHIRAHAMA (CHIBA Ken) and a master station at HAKONE (KANAGAWA Ken), with radio telephone communications. A brief description of the transmitting equipment follows. Additional information will be found in ATIG Report No. 115.

Frequency .....	1500 and 1750 kc
Pulse frequency .....	250 cycles sec
Pulse width .....	40 microseconds
Output .....	150 kw
Effective range .....	night, 3000 km; day, 1500 km
Accuracy .....	within 1%

The Navy had three types of radio beacons under development. They were as follows:

1. **MRB.** A variable 4-course radio beacon, on 3 mc, power 20 watts, range 60 km. Indication was aural A-N or A-I, or course indicator meter. A block diagram is shown in Enclosure (B).
2. **MKR.** This type (see block diagram, Enclosure C) operated on 6 mc. The principle of operation was described as follows: The 6 mc carrier was modulated with a very narrow pulse at 80 cycles/sec. Two crossed figure eight patterns were radiated by the crossed loops. The receiver used had a visual indicator on which the signals from two adjacent lobes of the transmitting antenna appeared as two vertical lines, perpendicular to the base line, the height of the vertical lines being proportional to the signal strength. "On-course" was indicated when the two lines were of the same length.
3. **URE.** This was a variable single-course A-N or A-I system on a frequency in the range 60 to 75 mc, power output, 30 watts, range, 40 km, accuracy within plus or minus 1° at 20 km. A doublet in a corner reflector was used as the antenna. See block diagram, Enclosure (D).

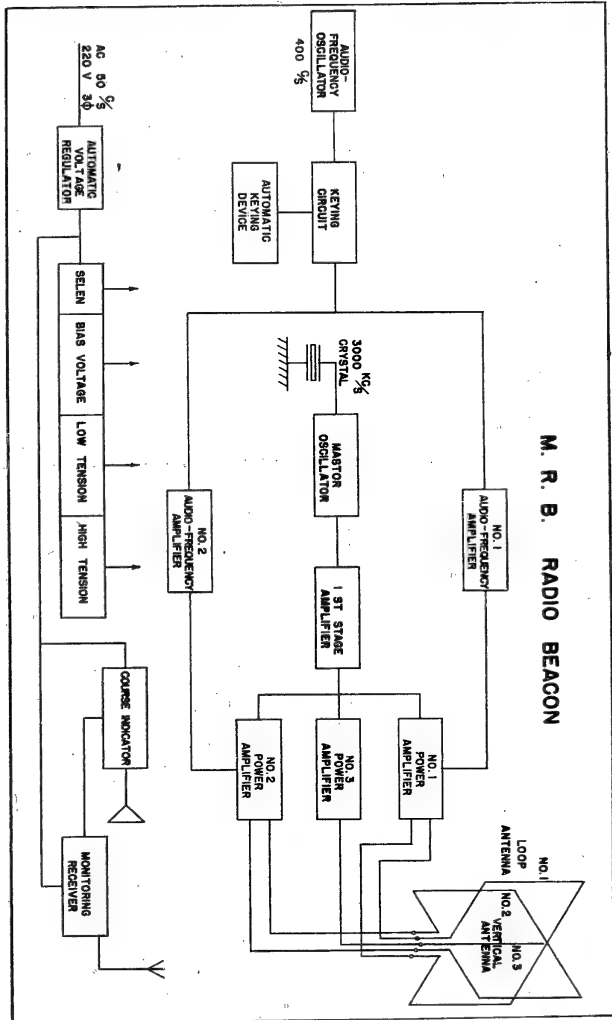
The Japanese Army had developed a modified Lorenz blind-landing system which was unsuccessful because its resolution at low angles was so poor that the pilots refused to use it.

## ENCLOSURE (A)

### LISTS OF DOCUMENTS FORWARDED TO THE WASHINGTON DOCUMENT CENTER THROUGH ATIS

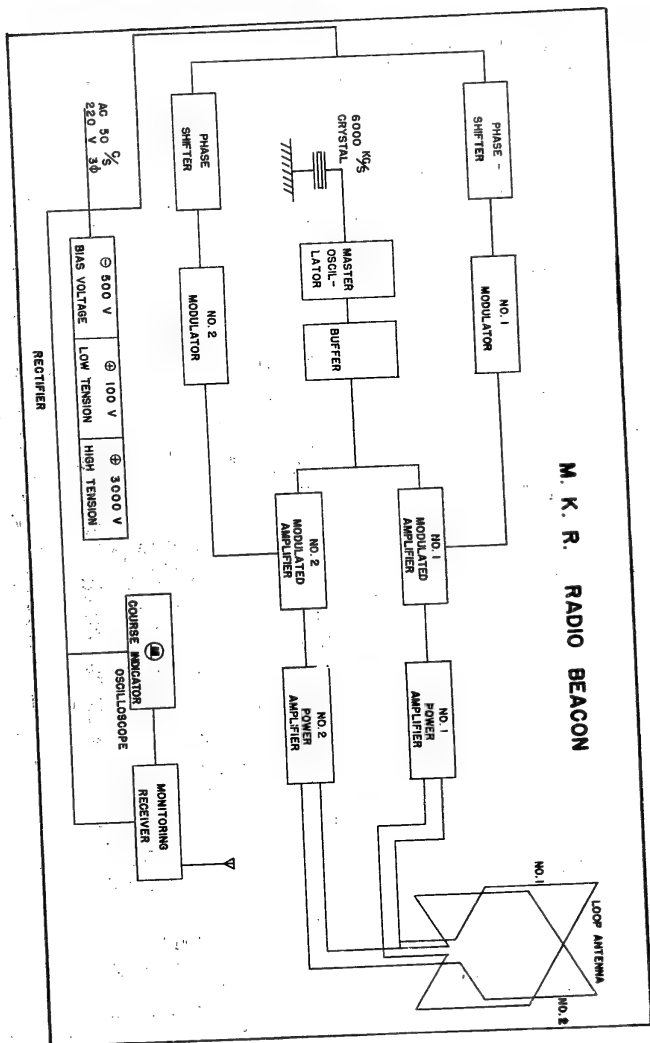
<u>NavTechJap No.</u>	<u>Title</u>	<u>ATIS No.</u>
ND21-6017	Experimental research on the small type medium wave radio navigation beacon	3302
ND21-6020	Experimental results on the ultra-short wave navigation beacon	3303
ND21-6127	Installation of Model 2, Mark 1 transmitter used with Type 96 Mark 1 radio beacon	3709
ND21-6128	Test report on ultra-short-wave radio beacon	3308
ND21-6130	Radio blind landing equipment	3310
ND21-6131	Tests of aircraft radio beacon	3311
ND21-6132	Tests of aircraft radio beacon	3312
ND21-6162	Experimental radio altimeter	3420
ND21-6226	Ultra-short wave aircraft navigation beacon	3319
ND22-3010	List of radio and radar equipment used by the Japanese Navy, including specification and operating characteristics	4342

ENCLOSURE (B)

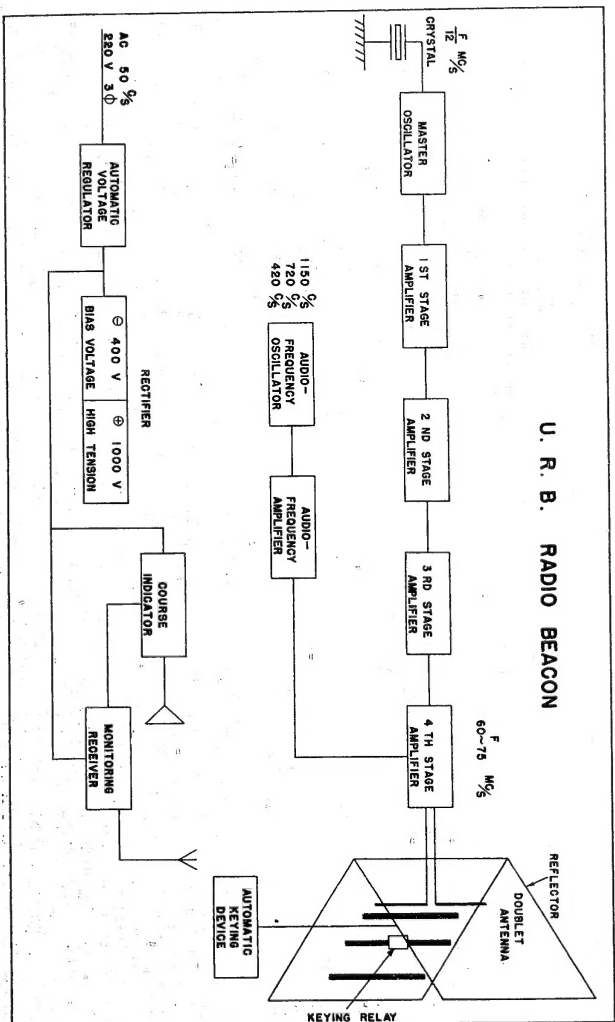


M. R. B. RADIO BEACON

## ENCLOSURE (C)



ENCLOSURE (D)



## ENCLOSURE (E)

FH-1 AIRCRAFT RADIO ALTIMETER**Transmitter**

Tube  
Modulating method  
Frequency  
Calibration modulator tube

"T-304A" x1  
Frequency modulation  
340 15 mc  
"SORA" x1

**Receiver**

Detector tube  
Audio amplifier  
Frequency counter  
Total audio gain

"UN-955" x1  
"SORA" x4  
"SORA" x2, "VRD-90/50" x1  
about 100 db

**Control Box**

Power Switch  
Calibration Switch  
Calibration Adjustment  
Sub-indicator

**Dynamotor**

250v 100ma

**Antennas (Transmitter and Receiver Antennas)**

Half-wave doublet

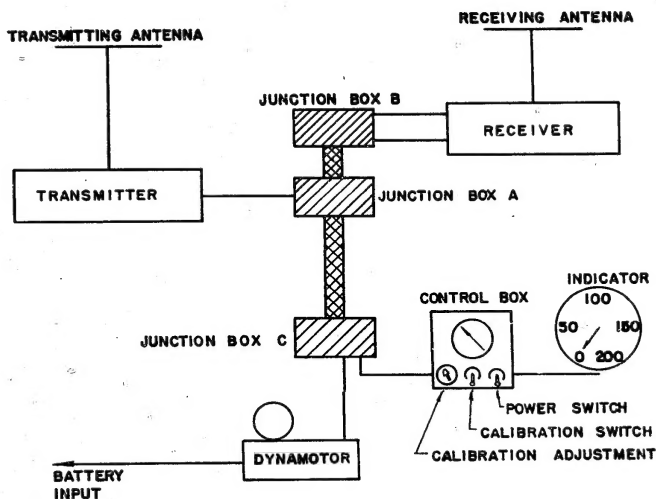
**Range**

From 10 to 150 m

**Error**

Within 5%

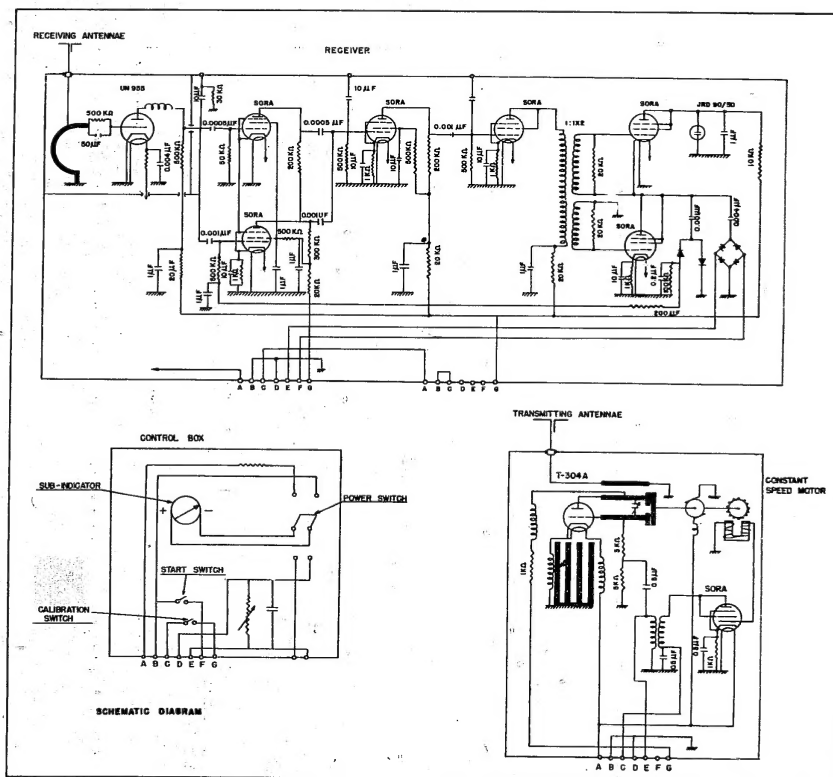
## CONNECTION DIAGRAM



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ENCLOSURE (E), continued



## ENCLOSURE (E), continued

